

## SEALING DEVICE

### Field of the Invention

The present invention relates to a sealing device for sealing a line relative to a line  
5 duct. The line is introducible at least partially into the line duct. A substantially tubular  
seal is disposed between the line and the line duct. The present invention further relates to  
a plug-in connector, which is connected to the line duct and comprises a sealing device.

### Background

10 Such sealing devices are generally used to protect components from the  
penetration of liquids, gases and/or impurities or to prevent gases or liquids from escaping  
from the component. In DE-OS 199 21 311 A1 such a sealing device is shown, which  
comprises a seal and a screw-down nut. The sealing between the line duct, for example a  
wall part of a housing, and the line, such as for example cables, pipes and similar elongate  
15 shaped parts, is achieved by pressing the smooth seal walls against the line, and the line  
duct.

With these sealing devices, however, reliable sealing of the line, mechanical strain  
relief of the line in the duct and possible rotation of the seal and the line are often  
problematic because greater manufacturing tolerances, particularly during manufacture of  
20 the seal, may lead to an inadequate mechanical contact between the seal and the  
respective wall of line and line duct.

### Summary

An object of the present invention is accordingly to provide an improved sealing  
25 device for sealing between a line and a line duct and/or an improved strain relief for the  
line.

In an embodiment of the invention a seal comprises a plurality of approximately  
equidistantly disposed sealing lips on the inner wall and/or outer wall. By using a

plurality of sealing lips it is possible to achieve a "multistage" sealing of the line relative to the seal and/or of the seal relative to the line duct. A plurality of sealing lips moreover has the effect of increasing the friction, which may be utilised for a further improvement of the strain relief.

5           By means of a screw-down nut, which may be provided in the sealing device, mechanical pressure may be exerted on the seal transversely relative to the longitudinal axis of the line duct. Twisting of the line relative to the line duct may be prevented in that the screw-down nut presses the sealing device firmly against the line and the friction between sealing device and line prevents twisting thereof. At the same time, the applied  
10       pressure effects strain relief of the line. The last-mentioned advantage in particular is of special importance in the case of the leading through of electric cables, for example of a sealed connection of cable and plug-in connector.

          In order to achieve a mechanically secure and also releasable connection of the screw-down nut to the line duct and guarantee ease of assembly, it is meaningful to  
15       provide screw-down nut and line duct at the appropriate points with a thread and hence enable their screw connection. Threads facilitate not only assembly but also the maintainability of the line duct, for example in a situation where it is necessary to exchange a seal that has become porous.

          A rotation of the seal and of the cable about their longitudinal axis, caused for  
20       example by attachment of the screw-down nut, gives rise to a high mechanical load and may therefore, for example in the case of use of the sealing device in an electrical plug-in connector, in which the electric cable is contacted by means of a crimp connection, lead to twisting-off of the crimp connection. According to a further preferred embodiment the seal therefore has an anti-rotation element to prevent rotation of the seal and of the line  
25       relative to the line duct.

          The anti-rotation element may be formed by an interlock between seal and line duct. In said case, it is already sufficient when the interlock is formed by a projection and a corresponding notch.

According to a further advantageous embodiment the seal comprises a circumferential stop projection, for bringing an end face into abutment with the line duct. Said stop projection may advantageously be utilised to form the anti-rotation element. Furthermore, by means of the stop projection the seal may also be fixed better in its  
5 position relative to the longitudinal axis.

It is further advantageous to select the dimensions of the profiles of the line, the line duct and the seal in such a way that on their connection, an interference fit is achieved. This makes it possible to reduce the clearances between the individual elements and hence additionally achieve an improvement of the imperviousness of the sealing  
10 device.

### **Brief Description of the Drawings**

The invention is described in detail below with reference to the embodiments which are illustrated in the accompanying drawings. Similar or corresponding details are  
15 provided with the same reference numerals in the drawings. In the drawings:

**Fig. 1** shows a side view of a plug-in connector with a sealing device according to the invention;

**Fig. 2** shows a detail shown in section along the cutting line A-A of the plug-in connector with a sealing device according to the invention;

20 **Fig. 3** shows a perspective view of the seal;

**Fig. 4** shows a perspective view of the plug-in connector of Fig. 1.

### **Detailed Description of the Preferred Embodiment**

Fig. 1 shows the side view of a sealed plug-in connector with a sealing device  
25 according to the invention. Attached to the housing 3 is a line duct 13, through which an electric cable 2 extends. The sealing device according to the invention may of course also be used with line ducts 13, which are attached to a device housing or are a pipe coupling

piece, for example for connecting two pipes in a sealed manner to one another. Provided on the line duct 13 is a thread 4, which may be screw-connected to a screw-down nut 1.

Fig. 2 shows a detail of the plug-in connector of Fig. 1 in a sectional view taken along the line A-A of Fig. 1. In the embodiment, the line duct 13 partially surrounds the seal 5. The seal 5 in turn encloses the line 2. By screwing the screw-down nut 1 onto the thread 4 the housing part provided with the thread 4 is pressed together with the seal 5 and the seal in turn is pressed together with the line 2 transversely relative to the longitudinal axis 8.

By virtue of a bevel 14, the seal 5 is pressed by the screw-down nut 1 against the housing 3 also in a direction parallel to the longitudinal axis 8 and the seal 5 is thereby fixed. For the functionality of the sealing device, it is not absolutely necessary to use a screw-down nut 1, it being equally possible to exert a radial and/or tangential force by means of other elements, such as for example sleeves with a toggle or clamping sleeves.

The illustrated inner sealing lips 6 and outer sealing lips 7 are pressed by the pressure exerted by the screw-down nut 1 against the line 1 and the housing 3 respectively, with the result that the plug-in connector is sealed. In the embodiment illustrated in Fig. 2 the seal 5 comprises in each case four inner sealing lips 6 and three outer sealing lips 7. It is equally possible to select any other number. The stop projection 10 of the seal 5 fixes the seal 5 in the longitudinal direction by virtue of the tangential force, which is exerted by the screw-down nut.

The internal diameter of the seal 5 is selected in such a way that during assembly the insulated electric cable 2 may be passed through the seal 5. The sealing lips 6, 7 of the seal 5 effect sealing relative to the cable 5 and the line duct 13 respectively through elastic or plastic deformation of the sealing lips, via the pressing force of the screw-down nut 1. Besides the friction locking between the individual elements that is required for this purpose, positive locking may also be used to effect sealing between the line duct 13 and the seal 5. For this purpose, on the inside of the line duct 13 facing the seal 5, grooves may be provided, into which the outer sealing lips 7 engage.

Fig. 3 shows a perspective view of a seal 5 designed in a rotationally symmetrical manner. The stop projection 10 fixes the seal 5 along the longitudinal axis 8 in the housing 3 by virtue of the pressing force exerted by the screw-down nut 1. An anti-rotation element 9 is formed on the side of the stop projection 10 facing the line duct provided on the housing 3. In the illustrated embodiment, the anti-rotation element 9 is formed by an interlock 11, for example a claw-type interlock. Situated along the outer periphery of the seal 5 are the outer sealing lips 7, which effect the sealing relative to the inner wall of the line duct 13. Formed on the inner periphery of the seal 5 are the inner sealing lips 6. The latter, as Fig. 2 reveals, effect sealing of the region of the line 2 located adjacent to the seal 5.

By virtue of an offset arrangement of the inner and outer sealing lips 6, 7 relative to one another it is possible to reduce the material cross-section in the seal 5. It is of course also possible to design the inner sealing lips 6 and outer sealing lips 7 in such a way that they are located opposite one another. On the front of the seal 5, as Fig. 2 also reveals, an insertion phase is formed by a bevel 14 on the outer side of the seal 5, so that the seal 5 may be introduced more easily into the line duct during assembly of the plug-in connector.

For the cross-section of the sealing lips 6, 7 various configurations customary in trade, such as a U shape for example, may be selected. The sealing lips 6, 7 may also be of a gill-shaped design, wherein corresponding bulges on the line duct may engage into the gaps between the gills.

Suitable materials for the sealing lips are materials, which are reliably impervious to liquids, gases and impurities, such as for example silicone rubber mixtures.

Fig. 4 shows the perspective view of the plug-in connector housing of Fig. 1. Situated on the housing 3 is the line duct 13, the free end of which is, in accordance with the rotationally symmetrical seal 5 shown in Fig. 3, shaped in such a way that the end may receive the seal 5 shown in Fig. 3. The interlock 12 is configured in a way that allows it to fit into the interlock 11 embossed on the seal 5. The fact that the seal 5 is joined in a precisely fitting manner to the line duct prevents the seal 5 from being able to twist relative to the line duct of the housing 3 during attachment of the screw-down nut 1.

In order to be able to attach the screw-down nut 1, in the manner shown in Fig. 1, to the line duct of the plug-in connector housing 3, on the outside of the line duct a thread 4 is provided, onto which the screw-down nut 1 may be screwed.

5 The illustrated plug-in connector housing may be connected in an impervious manner to a non-illustrated mating component so that the inner region of the plug-in connector housing and of its mating component is sealed off.

For assembly of the sealing device, first the end of the line 2 is passed through the screw-down nut in such a way that the nut in the last assembly step may be screw-connected to the thread 4 provided on the housing 3. Then the end of the line 2 is pushed  
10 through the seal 5 from the side thereof facing in the stop 10, so that the end of the line 2 projects out of the seal 5. The line with the screw-down nut mounted thereon may then be pushed into the corresponding end of the housing (line duct 13) and fastened by means of the screw-down nut 1.

Advantageously, the sealing lips on the inner and/or outer wall of the seal  
15 contribute substantially toward reliable sealing. The sealing lips effect improved sealing between the line duct and the seal and/or the seal and the line, which leads as a whole to an improvement of the overall sealing of the sealing device and its reliability. The sealing device further enables improved strain relief due to the increased friction. By virtue of the described properties it is possible by means of the solution according to the invention to  
20 create sealing devices, which result in reliable sealing and the use of which for example in a plug-in connector provides particularly good strain relief of the line.

Although the invention has been described above only in connection with a line duct, which is provided on an electric plug-in connector, and an electric cable, the sealing device may also be used for the sealing of pipes and other elongate shaped parts relative  
25 to any desired ducts.